



# Flood Protection and Hydraulic Design of the Water Transmission Line and Water Supply Network of Al-Badayera City

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## Abstract

Al Badayera City is one of the governorates of the Qassim region in the Kingdom of Saudi Arabia with an area of 1600 km<sup>2</sup>. Qassim has several water sources, and the largest proportion of groundwater (well water purification station) is 146 MCM, groundwater (direct underground wells) is 2 MCM, and desalinated water is 13 MCM. The governorate faces increasing challenges related to flooding, posing a threat to communities, infrastructure and the environment. This report outlines a comprehensive flood protection framework designed to mitigate the negative impacts of flooding in the region, draw IDF curve by using HEC SSP and delineates the catchment areas by using the QGIS and HEC-HMS.

GP1 performed the water network design serves to 2049 (after 25 years) with water treatment plant which located southwest the governorate with design capacity 100,000 m<sup>3</sup>/d and production capacity 59,196 m<sup>3</sup>/d, the pipes in network has diameter ranges from 100 to 800 mm with future demand 1047.8 l/s, the cost of pipes was 38,529,000 SR.

GP2 consists of studying the flood and how it is attacking the city and what is the possible solutions to alleviate the risk of floods. So, all of bridges, pond and culvert was designed by software such as HEC-RAS, HEC-HMS, HY-8 and TOOLBOX, dams were considered into account in delineation also ARF should be calculated.

Finally, two bridges, one pond and one culvert were designed in this project.

## Objectives

The objectives for GP1

- Design water supply network of Al-Badayera city.
- Draw IDF curve by use HEC SSP.
- Delineate the catchment areas by using the QGIS.

The objectives for GP2

Protect the Al Badayera City from flood

## Al Badayera City

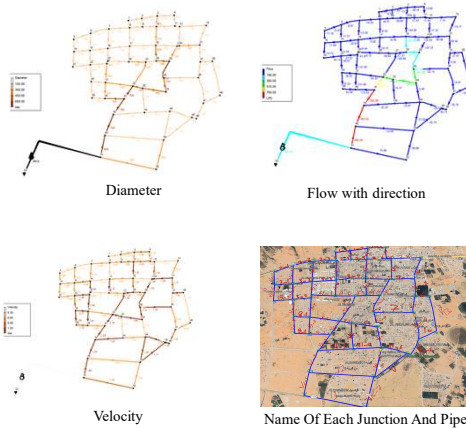
Al Badayera is a governorate in the Al-Qassim Region of Saudi Arabia. It covers 1,600 square kilometers (620 square miles) and has a population of 53,779 people [1]. Al Badayera is regarded as one of Qassim's agricultural governorates due to its central location. The governorate is located in the desert zone due to its latitude (26) north, where it is susceptible to harsh continental conditions. Drought prevails in the summer, temperatures rise, and sandstorms are common, whereas cold weather and more rains occur in the winter. The climate has a significant impact on human, animal, and plant life, among many other effects.



Al Badayera City

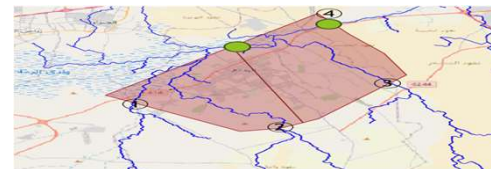
## Distribution Network

Design of Water Distribution Network using EPANET. This subsection presents the summary of the design of Water Distribution Network

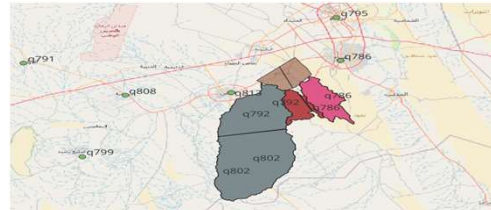


## Flood Protection Works

Al Badayera governorate, four wadis are attacking



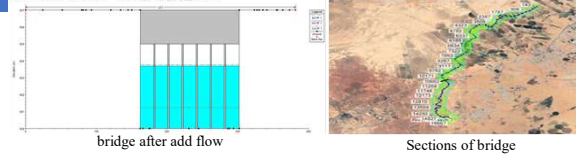
Location of four wadis



catchment area and effect of rainfall station (wadi one, two and three)

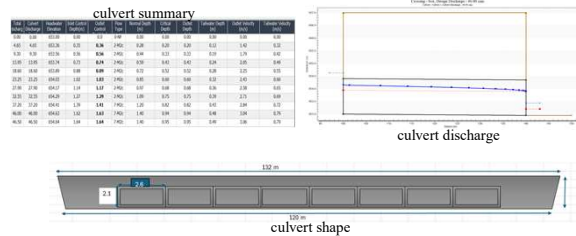
## ATTACKING WADI ONE

In attacking wadi one, a bridge will be designed to protect against floods, and RP will be 50 years. Design bridge using HEC-RAS



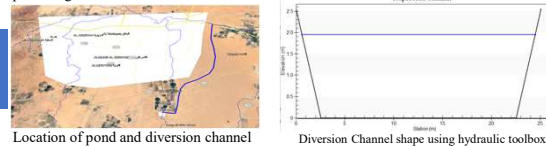
## ATTACKING WADI TWO

In attacking Wadi Two, a culvert will be designed to protect against floods. Design Culvert by using HY8



## ATTACKING WADI THREE

In attacking Wadi Three a pond will be designed with a return period of 2 years and a design diversion channel to protect against floods.

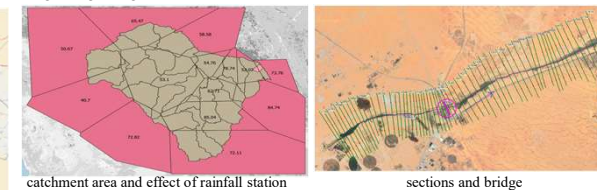


## Pond design

The shape :Square  
Volume =720800 m<sup>3</sup>  
Assume depth =5m  
Area = (volume)/depth=(720800)/5=144160 m<sup>2</sup> length =√Area=√144160=379 m  
Length of pond 400 m Area actual=160000 m<sup>2</sup> Volume actual =800000 m<sup>3</sup>

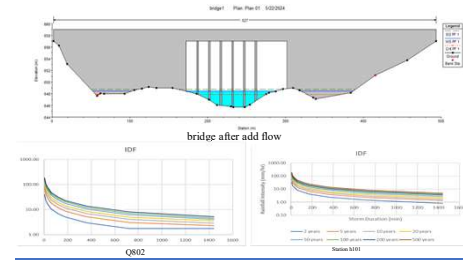
## ATTACKING WADI FOUR

In attacking wadi four, a bridge will be designed to protect against floods, and RP will be 50 years. Design bridge using HEC-RAS



catchment area and effect of rainfall station

sections and bridge



## CONCLUSIONS

### Hydraulic Design

- The future population was 143,482 Capita in 2049 and has been used Geometric Method of population.
- The future population's consumption is estimated at 20.116 m<sup>3</sup>/hour.

### Flood Protection Works

- Used Digital Elevation Model (DEM) 30×30 resolution for delineation and 12.5×12.5 for designing the bridges.
- Determined Rainfall stations affecting the study area
- Developing the IDF Curve for Rainfall stations by using SCS-Type II (Modified Bell) and Bell's Ratio then used SCS-Type II (Modified Bell)
- The HEC-HMS program was used to delineate the study area. 23 catchment areas were specified that attacking Al-Badayera.
- Find the dams which located in the catchment area with their information.
- Designing bridge, culvert, pond using HEC-RAS, HY-8 and Toolbox.

## Software Used

